

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

421919
4805
United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory



Dividends From Wood Research

Recent Publications

July—December 1987

explanation and instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer by the FPL Publications Section between July 1, 1987, and December 31, 1987.

Each publication listed in this brochure is available through at least one of the sources below. For each entry in the brochure, we indicate the primary source for that publication and show you how to obtain a copy:

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

list of categories

Publications are listed in this brochure within the following general categories:

Biodeterioration and protection
Chemicals from wood
Energy
Engineering properties and design criteria
General
Microbial and biochemical technology
Mycology
Processing of wood products
Pulp, paper, and packaging
Timber requirements and economics
Tropical wood utilization
Wood bonding systems

biodeterioration and protection

1. Changes in Chemical Components of Hardwood and Softwood by Brown-Rot Fungi

Highley, Terry L.
Mater. Org. 22(1): 39-45; 1987.

Miniature blocks of pine and maple wood were decayed by four brown-rot fungi: *Coniophora puteana*, *Leucogyrophana arizonica*, *Poria placenta*, and *Gloeophyllum trabeum*. The blocks were decayed over a soil medium and a low-nutrient agar medium. Quantitative changes in lignin, glucan, mannan, and xylan during decay were determined. Removal of cell wall components by the fungi was similar in both pine and maple and by both decay tests. The fungi removed the polysaccharides but only slightly depleted the lignin. The mannan was removed substantially faster than glucan or xylan. Xylan was usually depleted faster than glucan.

2. Biochemical Aspects of White-Rot and Brown-Rot Decay

Highley, Terry L.
1987 May 17-22; Canada. Document IRG/WP/1319.
Stockholm, Sweden: IRG [International Research Group on Wood Preservation] Secretariat; 1987. 22 p.

This paper presents an overview of the decomposition of wood by white- and brown-rot fungi—the most important and potent of known wood-decay fungi. These organisms are unique among cellulose destroyers because of their strong capability to enzymatically degrade lignified material. Special emphasis is given to the following aspects of wood decomposition by white- and brown-rot fungi: (1) effects on the chemical and physical properties of wood, (2) method of invasion and ultrastructural modification of wood, (3) nature and activities of extracellular degrading enzymes, (4) relationship of ultrastructural changes to the degradative enzyme systems, and (5) unique physiological features of the fungi that can be used to control decay.

3. Effect of Wrapping on Movement of Chloropicrin, Vapam, and Vanicide TH in Southern Pine Timbers

Highley, Terry L.
1987 May 17-22; Canada. Document IRG/WP/3411.
Stockholm, Sweden: IRG [International Research Group on Wood Preservation] Secretariat; 1987. 7 p.

Important fungi that decay wood products were "inoculated" into nonpressure-treated southern pine timbers as vapor-sensing agents to evaluate the effect of wrapping on the movement and persistence of fungitoxic concentrations of chloropicrin, Vapam, and Vanicide TH in the timbers. Fumigant movement and persistence in the timbers were enhanced by wrapping the timbers in polyethylene after fumigation.

4. Movement of Chloropicrin, Vapam, and Methylisothiocyanate in Southern Pine and Douglas Fir Timbers

Highley, Terry L.
1987 May 17-22; Canada. Document IRG/WP/3410.
Stockholm, Sweden: IRG [International Research Group on Wood Preservation] Secretariat; 1987. 15 p.

Douglas fir and southern pine timbers, 15.2-cm x 15.2-cm x 4.26-m (6-in x 6-in x 14-ft), were "inoculated" with brown-rot and white-rot fungi as vapor-sensing agents to evaluate the movement and distribution of fungitoxic concentrations of chloropicrin, Vapam, and methylisothiocyanate (MIT) over a 20-week period. Residual fumigant in timbers was determined by a bioassay with *Gloeophyllum trabeum*.

5. Physical, Chemical and Biochemical Considerations in the Biological Degradation of Wood

Jeffries, T. W.
In: Kennedy, J. F.; Phillips, G. O.; Williams, P. A., eds.
Wood and cellulose: Industrial utilisation, biotechnology, structure and properties. West Sussex, England: Ellis Horwood Limited; 1987: 24.

The relationships among wood structure, chemistry, and biological decomposition have been reviewed many times in articles and occasionally in complete texts. This paper resynthesizes past knowledge with a few major recent findings and relates tissue and polymer structures of wood to mechanisms for their biological and biochemical degradation.

6. Protection of Timber Bulkheads From Marine Borers

Johnson, Bruce R.
In: Graham, James, ed. Timber bulkheads. Geotech. Spec. Pub. No. 7: Proceedings; Geotechnical Engineering Division of the American Society of Civil Engineers; 1987 April 29; Atlantic City, NJ. New York: American Society of Civil Engineers; 1986: 16-34.

Timber bulkheads are susceptible to degradation by a variety of marine organisms. Preservative treatment can prevent this degradation but only if the treatment is properly specified and accomplished for the particular exposure site. This paper describes the principal types of wood-degrading marine borers and their environmental requirements, geographic distribution, and preservative tolerance. Some results of the Forest Products Laboratory's marine exposure tests are presented, and some potential pitfalls in the preparation of treatments for timber bulkheads are discussed.

7. Physical Properties of β -1,4-Xylanase Produced by *Postia* (= *Poria*) *Placenta*: Implications for the Control of Brown Rot

Micales, J. A.; Green, F., III; Clausen, C. A.; Highley, T. L.
1987 May 17-22; Canada. Document IRG/WP/1318.
Stockholm, Sweden: IRG [International Research Group on Wood Preservation] Secretariat; 1987. 11 p.

The degradation of hemicelluloses is an early event in wood decay by brown-rot fungi. An understanding of the physical properties of hemicellulases may suggest target mechanisms for the development of new control agents. Endo- β -1,4-xylanase was partially purified by column chromatography from wood decayed by *Postia* (= *Poria*) *placenta*. The enzyme was extremely resistant to denaturing conditions; no loss of activity was detected after 2 hours in 9 M urea or 6 M guanidine-HCl. Boiling the enzyme for 5 minutes in 2.5 percent SDS + 0.5 percent β -mercaptoethanol reduced its activity by 65 percent, as measured by the production of reducing sugars. The activity of α -D-galactosidase, another enzyme detected in large quantities in the decayed wood, was reduced by 98 percent under these conditions. Optimum pH and temperature ranges were pH 2 to 6 and 50 to 60°C, respectively. The enzyme appears to be a glycoprotein containing 50 to 60 percent carbohydrate (w/w); the carbohydrate moiety may protect the enzyme from adverse environmental conditions. The control of brown rot by *in situ* inactivation of xylanase may not be feasible because of the enzyme's extreme stability.

8. Adhesion of Paint to Weathered Wood

Williams, R. Sam; Winandy, Jerrold E.; Feist, William C.
Forest Prod. J. 37(11/12): 29-31; 1987.

The objective of this study was to quantify the loss of primer paint adhesion to boards weathered outdoors for a short time prior to being painted. Following outdoor weathering for up to 16 weeks, western redcedar (*Thuja plicata* Donn) boards were painted with alkyd oil or acrylic latex primer paints and tested in shear or tension to determine paint adhesion. The tensile strength of the paint/wood bond dropped 50 percent from approximately 300 lb/in² (2,068 kPa) on wood weathered for 4 weeks to 150 lb/in² (1,034 kPa) on wood weathered for 16 weeks. Shear strength dropped 33 percent from approximately 750 lb/in² (5,171 kPa) to 500 lb/in² (3,447 kPa) after similar weathering periods.

9. Paint Adhesion to Weathered Wood

Williams, R. Sam; Winandy, Jerrold E.; Feist, William C.
J. Coatings Technol. 59(749): 43-49; 1987.

The objective of this study was to measure quantitatively the loss of primer paint adhesion to boards weathered before painting. Outdoor exposure was for relatively short periods in the late spring and summer months and ranged from 1-16 weeks. This exposure would be typical of the weathering wood siding might get during new construction. Adhesion was determined by tensile and shear tests similar to those used for testing wood-adhesive bonds. Measurement of paint adhesion may be a useful diagnostic tool for predicting the performance of paint systems applied to wood and wood-based composites. The decrease in paint adhesion to weathered wood reported here will be correlated with paint performance on wood panels that are currently being exposed outdoors. The long-range objective is to relate paint adhesion to paint and finish performance.

chemicals from wood

10. Dimeric Components From the Dimerization of Abietic Acid

Fujii, R.; Arimoto, K.; Zinkel, D. F.
JAOCS. 64(8): 1144-1149; 1987.

Capillary gas-liquid chromatography of the product formed by sulfuric acid-catalyzed dimerization of abietic acid showed the presence of some 40 dimeric components. Three major components were isolated and shown to be heptacyclic dimers, two of which had a conjugated double bond system. The other component had two nonconjugated double bonds. Also isolated were three dimers consisting of monomers attached through a single carbon-carbon bond; one carboxyl group in each of these dimers was in the form of a γ -lactone.

11. Stereochemistry of the Tetrahydroisopimaric Acids: X-Ray Structure of Methyl 8 α -Isopimarane-18-oate

Zinkel, Duane F.; Pettersen, Roger C.; Haromy, Tuli; Sundaralingam, Muttaiya
J. Chem. Soc. Perkin Trans. I: 1975-1977; 1987.

Diterpene resin acids of the abietane, pimarane, and isopimarane types are the primary components of commercial resins. In the course of isolating and purifying these acids and their hydrogenated derivatives to obtain standard spectra, we discovered a second tetrahydroisopimaric acid hitherto unreported. This paper reports the isolation and identification of this tetrahydroisopimaric acid and compares it with the previously reported compound.

12. Use of Wood Energy in the United States—An Opportunity

Koning, John W., Jr.; Skog, Kenneth E.
Biomass. 12: 27-36; 1987.

13. Use of Wood for Energy in the United States—A Threat or a Challenge?

Koning, John W., Jr.; Skog, Kenneth E.
In: Klass, Donald, ed. Energy from biomass and wastes X.
Chicago: Institute of Gas Technology; 1987: 1309-1319.

On the basis of estimates of heavy wood energy use relative to other uses for wood, and estimates of continuing high costs for fossil fuels, these papers (12, 13) suggest the feasibility of meeting the demand for fuelwood through small-scale cooperatives. Such an approach can improve forestry practices and can avoid unduly increasing the cost of wood for other end uses.

engineering properties and design criteria

14. Quality Impacts of the Changing Timber Resource on Solid Wood Products

Bendtsen, B. Alan
In: Robertson, Doris, coord. Managing and marketing the changing timber resource: Proceedings 47349; 1986 March 18-20; Fort Worth, TX. Madison, WI: Forest Products Research Society; 1987: 44-57.

This paper presents a summary of properties of juvenile wood from the fast-grown resource, which have importance to solid wood utilization. Emphasis is on lumber, although plywood and composite products are addressed. Suggestions are made regarding where future efforts should be focused to improve processing and utilization of material from the changing resource, and how to improve the resource itself.

15. Comparative Performance of Timber Bridges

Gutkowski, Richard M.; McCutcheon, William J.
J. Struct. Eng. 113(7): 1468-1486; 1987.

Eighteen timber bridges built in the late 1960s and early 1970s were inspected to determine the performance of their various components. In general, the bridges are in excellent structural condition. Glulam decks provide effective "roofs" over stringers, as shown by relatively low moisture content readings in the stringers. The findings support the use of dry use design stresses for stringers but not for decks.

Material Design Factors for Hardwood Laminated-Veneer-Lumber

Hoover, William L.; Ringe, James M.; Eckelman, Carl A.; Youngquist, John A.
Forest Prod. J. 37(9): 15-23; 1987. (Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost \$2 each, with \$5 minimum, plus 10 percent postage and handling.)

The cooperative research reported in this paper provided a procedure for designing and specifying laminated-veneer-lumber (LVL) to satisfy load requirements in the furniture industry. This paper reports on experimental results and the design model developed to predict the properties of LVL. The experiment was designed to provide the broad data base needed for the development of predictive models. It was not designed to investigate causal relationships.

High-Temperature Kiln-Drying of 1-Inch Red Alder Lumber

Kozlik, Charles J.; Boone, R. Sidney
Forest Prod. J. 37(6): 21-24; 1987. (Available from College of Forestry, ATTN: Publications; Oregon State University; Corvallis, OR 97331. No charge.)

A four-step study of various high-temperature kiln schedules was conducted on green, 1-inch red alder lumber. The objective was to find a shortened schedule yielding lumber comparable to that obtained with commercial schedules in terms of four criteria: minimal degrade at 7 percent average moisture content, good color and uniformity, dryness without excessive shrinkage, and repeatable results.

16. Creep and Creep-Rupture in Reconstituted Panel Products

Laufenberg, Theodore
In: Proceedings of the International workshop on duration of load in lumber and wood products; 1985 September 12-13; Vancouver. Vancouver: Forintek Canada Corp.; 1986: 61-66.

Commercially produced plywood, oriented strandboard, and wafer-board of varying constructions are tested to identify the variables most influential in flexural creep and creep-rupture performance. Environmental conditions are varied for creep tests but held constant for creep-rupture tests. The test program is intended to provide a broad data base on the rheological properties and duration-of-load behavior of panel products for preliminary design usage.

17. Performance and Rehabilitation of Timber Bridges

McCutcheon, William J.; Gutkowski, Richard M.; Moody, Russell C.
In: Trans. Res. Rec. 1053. Washington, DC: Transportation Research Board, National Research Council; 1986: 65-69.

Eighteen timber bridges were inspected to assess their long-term performance. In general, they were in excellent structural condition with glued-laminated decks performing better than nailed-laminated decks. Extensive moisture content readings indicated that wet-use stresses should be used when designing bridge decks, regardless of deck type or treatment. Dry-use stresses are appropriate for the stringers. A comprehensive program, including new technologies and demonstration projects, must be developed to address the repair and rehabilitation of older nailed-laminated decks.

18. Fracture Mechanics: A Tool for Predicting Wood Component Strength

Patton-Mallory, Marcia; Cramer, Steven M.
Forest Prod. J. 37(7/8): 39-47; 1987.

The authors propose using fracture mechanics to predict the failure of wood components when propagating cracks are a major contributor to failure. This proposal is accompanied by a review of fundamental concepts, techniques for computing stress-intensity factors, methods for measuring critical stress-intensity factors (K_{IC} and K_{IIIC}), and a summary of known K_{IC} and K_{IIIC} properties for different wood species. Included is a summary of wood-related fracture publications, compiled from the vast fracture literature. Finally, the authors identify research needed to incorporate the methods of fracture mechanics into design guidelines. This paper should be valuable to researchers and practitioners beginning studies on the strength or fracture of wood.

19. Predicting Racking Performance of Walls Sheathed on Both Sides

Patton-Mallory, Marcia; McCutcheon, William J.
Forest Prod. J. 37(9): 27-32; 1987.

This paper extends a previously developed wall racking model to the case of walls sheathed on both sides with dissimilar materials. (The previous model considered sheathing on one side only.) Four types of curves representing fastener load-slip data predict wall load-displacement behavior. Comparing theoretical computations to data from small wall tests, the authors found that asymptotic fastener

curves give the best predictions of shear wall performance. The results of this study should be of interest to researchers in light-frame wood construction and to building code authorities.

20. Proof Loading to Assure Lumber Strength

Woeste, F. E.; Green, D. W.; Tarbell, K. A.; Marin, L. A. *Wood Fiber Sci.* 19(3): 283-297; 1987.

In this study the authors determined the effect of edgewise bending proof loads on the tensile and bending strength of dimension lumber. Both single and reverse proof load situations are investigated. The single proof loaded specimens are subjected to a bending proof load on a randomly selected edge. The reverse proof loaded pieces have loads applied to each of the beam edges in sequence, prior to their destruction in either a bending or tension mode. The percentage of material breakage and possible damage resulting from the proof loading procedure are considered.

21. Modeling the Structural Performance of Light-Frame Roof Systems

Wolfe, Ronald W.; Varoglu, Erol

In: CIB 86: Advancing building technology: Proceedings of the 10th Triennial Congress of the International Council for Building Research, Studies and Documentation; 1986 September 22-26; Washington, DC. Gaithersburg, MD: [Center for Building Technology]; 1986: 2672-2679.

Improved efficiency in the design of light-frame roof systems is inhibited partially by traditional wood design assumptions, and partially by the lack of data and analytical models needed to characterize light-frame system performance. The authors describe a research program initiated to evaluate system performance. As part of this program, four full-scale roof systems were tested to demonstrate the advantages of system interactions to the stiffness and strength performance of individual rafters and to provide a data base for the evaluation of a full-system model. An analytical computer model is currently in the evaluation stages. Once verified, this model will provide a low-cost alternative to full-system testing as a means of characterizing system sensitivity to design and construction variables.

general

22. Forest Harvesting, Wood Utilization, and Products of the Future

Montrey, H. M.; Zerbe, John I.

In: Crowley, John J., ed. 1986 Yearbook of agriculture: Research for tomorrow. 1986: 253-261.

Future research on wood will focus on more closely matching product end-use requirements with raw material quality and processing technology. Research and development efforts can lead to improved harvesting methods, higher levels of forest land management, and increased benefits. The authors describe several areas of future wood research in housing construction, on improvements in processing wood raw materials, and on new wood industrial chemical and biotechnology products.

New Ideas for Timber Bridges

Oliva, Michael G.; Tuomi, Roger L.; Dimakis, A. G.

In: Trans. Res. Rec. 1053. Washington, DC: Transportation Research Board, National Research Council; 1986: 59-64. (Available from Information Services Division, Kurt F. Wendt Library, University of Wisconsin-Madison, 215 North Randall Avenue, Madison, WI 53706; \$5.)

The fact that nearly half the bridges in the United States are listed as either functionally or structurally deficient lends impetus to search for new ideas for building and maintaining bridges. The Forest Service, U.S. Department of Agriculture, with a vast number of bridges under

its care, is cooperating with the University of Wisconsin to investigate new techniques for timber bridge design and construction. Described in this paper are promising new ideas, which are being examined for bridge construction, rehabilitation, and production of efficient performance and low cost in timber bridge systems.

23. Treatments that Enhance Physical Properties of Wood

Rowell, Roger M.; Konkol, Peggy

USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-55; 1987. 12 p.

This paper was prepared for anyone who wants to know more about enhancing wood's physical properties, from the amateur wood carver to the president of a forest products company. The authors describe chemical and physical treatments of wood that enhance the strength, stiffness, water repellency, and stability of wood. Treatment methods and properties and applications of treated wood are described in the text and summarized in a table. Though some of the chemical reactions described are complex, the language used to describe them is not. Several terms are defined in a glossary.

24. Kiln-Drying Time of Split Oak Firewood

Simpson, William T.; Boone, R. Sidney; Chern, Joseph

USDA Forest Serv. Res. Note FPL-RN-0254; 1987. 5 p.

This paper gives results of drying split, debarked, oak firewood kiln-dried at 140, 180, and 220 °F from 52 to 20 percent moisture content (dry basis) in 260, 90, and 30 hours. Pieces stacked parallel to the direction of airflow dried as quickly as pieces piled randomly.

microbial and biochemical technology

25. Influence of Molecular Size and Ligninase Pretreatment on Degradation of Lignins by *Xanthomonas* sp. Strain 99

Kern, Hartmut W.; Kirk, T. Kent

Appl. Environ. Microbiol. 53(9): 2242-2246; 1987.

The purpose of this study was to examine the relationship between the molecular size of lignin in several preparations and extent of degradation (mineralization) by *Xanthomonas* sp. strain 99. The influence of ligninase pretreatment was also examined. Five synthetic lignins and one ¹⁴C-methylated spruce lignin were used. The extent of mineralization to ¹⁴CO₂ was greatest for the samples containing the most low-molecular-weight materials, and the low-molecular-weight portions were preferentially (or perhaps solely) degraded. Pretreatment of the five synthetic lignins with crude ligninase increased their molecular size and decreased their degradability by the xanthomonad. Pretreatment of the methylated spruce lignin with crude ligninase caused both polymerization and depolymerization but resulted in a net decrease in bacterial degradability. Results suggest that the xanthomonad can degrade lignins only up to a molecular weight of 600 to 1,000.

26. Involvement of a New Enzyme, Glyoxal Oxidase, in Extracellular H₂O₂ Production by *Phanerochaete chrysosporium*

Kersten, Philip J.; Kirk, T. Kent

J. Bacteriol. 169(5): 2195-2201; 1987.

The importance of extracellular H₂O₂ in lignin degradation has become increasingly apparent with the recent discovery of H₂O₂-requiring ligninases produced by white-rot fungi. A new H₂O₂-producing activity of *Phanerochaete chrysosporium* is described that involves extracellular oxidases able to use simple aldehyde, α-hydroxycarbonyl, or α-dicarbonyl compounds as substrates. The activity is expressed during secondary metabolism, when the ligninases are also expressed. Analytical isoelectric focusing of the extracellular proteins, followed by activity staining, indicated that minor proteins with broad substrate

specificities are responsible for the oxidase activity. Two of the oxidase substrates, glyoxal and methylglyoxal, were also identified, as their quinoxaline derivatives, in the culture fluid as secondary metabolites. The significance of these findings is discussed with respect to lignin degradation and other proposed systems for H_2O_2 production in *P. chrysosporium*.

27. Lignin-degrading Enzymes

Kirk, T. K.
Phil. Trans. R. Soc. Lond. A321: 461-474; 1987.

The substantial potential applications of lignin-degrading microbes and enzymes have spurred research on lignin biodegradation in recent years. As described here, that research has led to the discovery in the basidiomycete *Phanerochaete chrysosporium* of the first lignin-degrading enzymes and elucidation of their mode of action. A family of powerful extracellular peroxidase isoenzymes has been the focus of most investigations. The key catalytic reaction of these glycoproteins, in the presence of hydrogen peroxide, is one-electron oxidation of aromatic nuclei, generating unstable aryl cation radicals. These decompose via a number of reactions, which have been elucidated with dimeric model compounds for lignin. The involvement of carbon-centred and peroxy free-radical intermediates has been established. The peroxy intermediates result from the addition of molecular oxygen to the C-centred radicals. Strong evidence for a classical peroxidase-type catalytic cycle of the ligninases has been obtained. The major research need is to identify the full complement of enzymes needed to degrade lignin to small fragments; this degradation is not accomplished by the isolated ligninases or by the crude extracellular mixture of enzymes secreted by cultures as they degrade lignin.

mycology

Decay Fungi and Wounding in Advance Grand and White Fir Regeneration

Aho, Paul E.; Filip, Gregory M.; Lombard, Frances F.
Forest Sci. 33(2): 347-355; 1987. (Available from Publications; Pacific Northwest Forest and Range Experiment Station (PNW), P. O. Box 3890, Portland, OR 97208.)

A total of 464 living white and grand fir tree stems in 24 stands in Oregon and Washington were dissected to detect infections of hymenomycetes (decay fungi) and other microorganisms in wood tissue. Of 21,249 attempted isolations from dissected trunks, 43.2 percent yielded bacteria or yeasts, 38.6 percent were sterile, 11.0 percent were nonhymenomycetes, 3.1 percent were hymenomycetes, and 4.1 percent were contaminated or mixed cultures. Hymenomycetes most frequently isolated were *Echinodontium tinctorium* and *Heterobasidion annosum*, both of which caused the most discoloration and decay. Nearly 20 percent of all hymenomycetous isolations, particularly *Hericium abietis* and *E. tinctorium*, were from clear tissue not associated with discolored or decayed wood.

28. Growth of the White-Rot Fungus *Phanerochaete chrysosporium* in Soil

Lamar, Richard T.; Larsen, Michael J.; Kirk, Kent T.; Glaser, John A.
In: Land disposal, remedial action, incineration and treatment of hazardous waste: Proceedings, 13th Annual Research Symposium; 1987 May 6-8; Cincinnati, OH. Cincinnati, OH: U.S. Environmental Protection Agency; 1987: 419-424.

Phanerochaete chrysosporium is a white-rot fungus with a demonstrated ability to degrade chlorinated organics in pure liquid culture to carbon dioxide. This ability suggests that the fungus may have potential as an *in situ* hazardous waste degrader. However, no data exist regarding the ability of *P. chrysosporium* to survive and grow in soil. That information is required for an effective evaluation of the ability of the fungus to degrade organo-pollutants *in situ*. The objective of this study was to investigate the influence of soil biotic and abiotic factors on survival and growth of the organism. It summarizes our research results to date on the effects of soil type, temperature, water potential, and acidity on growth of the fungus in sterile soils.

processing of wood products

29. Comparison of Four Methods for Drying Bacterially Infected and Normal Thick Red Oak

Ward, James C.; Simpson, William T.
Forest Prod. J. 37(11/12): 15-22; 1987.

This report describes a study where four drying procedures for 9/4 northern red oak were compared for drying time and volume loss due to drying defects. Mixed kiln loads of bacterially infected and normal 9/4-inch-thick northern red oak lumber (*Quercus rubra* L.) were dried from green to 6 percent moisture content (MC) by four different processes: conventional kiln-drying from green; dehumidifier kiln-drying to approximately 20 percent MC followed by kiln-drying to 6 percent MC; predrying in a commercial predryer to approximately 20 percent MC followed by kiln-drying to 6 percent; and vacuum drying.

pulp, paper, and packaging

30. A Method for Mechanical Property Testing of Paperboard During Compressive Creep in a Cyclic Humidity Environment

Considine, J. M.; Gunderson, D. E.
Experimental Techniques. 11(9): 18-21; 1987.

This paper describes an apparatus designed and built at the Forest Products Laboratory to measure stiffness, compressive creep, and the compressive strength of paperboard. The specimen and load frame fit into a small controlled environment chamber to allow mechanical testing of paperboard in constant or transient environmental conditions.

31. Disc Separation: Wetting Angle Differences

Klungness, John H.
Tappi J. 70(7): 125-127; 1987.

The difficulty in removing synthetic adhesive contaminants from wastepaper pulps is caused mainly by the nonwettable contaminants having about the same size and density as wetted pulp fibers. Present screening and cleaning operations are not effective in removing them. To demonstrate that disc separation can separate fibers based on their wetting angle differences, an experiment was performed by disc separating a slurry of two different fibers. These fibers had different wetting angles, nearly identical densities, and diameters that opposed the separation based on wetting angles. One was a commercial nylon fiber, and the other was a hot-melt adhesive (HMA) fiber produced in the laboratory. The results encourage development of disc separation for removing such contaminants from wastepaper pulps.

32. Disc Separation: The Effect of Disc Geometry

Klungness, John H.; Evans, James W.
Tappi J. 70(8): 107-110; 1987.

Net cleaning value is the economic value added to the wastepaper pulp by removing the contaminants, corrected for the fiber lost to the rejects, minus the cost of the energy consumed in the separation process. This study was undertaken to determine whether changing the geometry of a 152-mm-diameter disc from that of a flat surface to one having a concave indentation would improve the net cleaning value. Hot-melt adhesive contaminant was removed from a simulated pulp furnish composed of corrugated fiberboard. At optimum operating conditions, a net cleaning value of \$129 per metric ton was obtained for a flat disc, compared with a measured \$125 per metric ton for the indented disc. The energy saved from the reduced speed requirement for the indented disc was more than offset by an increase in fiber loss, from 5.9 percent for the flat disc to 9.9 percent for the indented disc. Contaminant removal was slightly higher for the indented disc.

33. Cushioning Properties of Corrugated Pads in Edge and Corner Drop Tests

Liu, Jen Y.; Laundrie, James F.
Boxboard Containers. 1987 May: 28-33.

This study is an extension of a previous study (Liu and Laundrie 1985) in which the cushioning properties of several spring and folded pads of corrugated fiberboard were evaluated in flat drop tests. This report evaluates the cushioning properties of one specific design of corrugated fiberboard folded pads in edge and corner drop tests.

34. Feasibility of Using an Ammonium-Based Lignosulfonate Binder System for Medium-Density Hardboard

Myers, Gary C.
Forest Prod. J. 37(10): 63-67; 1987.

Dry process medium-density hardboards were manufactured containing 12 and 16 percent lignosulfonate adhesive. Another set of medium-density hardboards was also made containing 8 percent phenol-formaldehyde adhesive to serve as a control. The lignosulfonate adhesive was applied as a spray-dried powder, and the phenolic adhesive was applied as a liquid. Hardboards were evaluated by static bending, internal bond, and change in dimension and weight with moisture changes. Lignosulfonate-bonded hardboards were lower than phenolic-bonded hardboards in static bending properties, but the lignosulfonate-bonded boards were superior in internal bond properties, especially when 16 percent resin was used. Lignosulfonate-bonded hardboards had excellent strength retention after a 24-hour water-soak, but deteriorated badly during the accelerated-aging procedure. Lignosulfonate-bonded hardboards had greater linear and weight changes than phenolic-bonded hardboards, but less thickness change.

35. The Effects of Polymeric Additive on Papermaking

Wegner, Theodore H.
Tappi J. 70(7): 107-111; 1987.

The effect of a cationic polyacrylamide was determined, not only on pulp slurry drainage rate but also on web vacuum dewatering response, web behavior during wet pressing, web drying rate, and sheet tensile and burst strengths. Various amounts of polyacrylamide were used with a 51-percent yield red oak kraft fiber furnish to form 273- and 205-g/m² webs. As polyacrylamide level was increased, the drainage rate of the pulp slurry increased, and web dryness decreased in response to vacuum. Over the levels studied, polyacrylamide had no effect on web behavior during wet-press dewatering. Polyacrylamide did, however, reduce the web drying rate and sheet burst index at the higher concentration (0.25 pct) of polyacrylamide. At a lower level (0.10 pct), web drying rate and sheet burst index were not affected. Sheet tensile index was not affected by polyacrylamide at either level.

timber requirements and economics

Effect of the Energy Crisis on the Elasticities of Demand for Forest Products in OECD Countries

Buongiorno, Joseph; Chang, Ham Shee
Can. J. For. Res. 16: 968-974; 1986. (Available from Department of Forestry, University of Wisconsin, Madison, WI 53706. No Charge.)

The purpose of this paper was to test if there had been systematic changes in the income and price elasticities of demand for forest products after the first oil embargo of 1973. The test used pooled data from 10 Organization for Economic Cooperation and Development (OECD) countries between 1961 and 1981. Eight commodity groups

were considered: coniferous sawn wood, nonconiferous sawn wood, plywood, particleboard, fibreboard, newsprint, other printing and writing paper, and other paper and paperboard. The demand models used were distributed lags on first logarithmic differences of income and price in each country and year.

PAPYRUS: A Model of the North American Pulp and Paper Industry

Gilliss, J. Keith; Buongiorno, Joseph
Forest Sci. 33(1): 1-37; 1987. Monograph 28. (Available from Department of Forestry, University of Wisconsin, Madison, WI 53706. No Charge.)

A spatial equilibrium model of the North American pulp and paper industry was developed to provide long-range projections of production, consumption, imports, exports, equilibrium prices, and fiber inputs. The model consists of a price-endogenous linear program that describes the industry in 1 year, and a set of recursive relationships that update this linear program from year to year to reflect endogenous and exogenous changes. The linear program incorporates supply curves for raw materials, an activity analysis representation of manufacturing and transport activities, and demand curves for final products and exports. The optimal solution to the linear program is the competitive equilibrium for the industry in a given year. Fourteen commodities are recognized in the model: softwood and hardwood roundwood and residues, mechanical, semichemical, and chemical pulp, newsprint, paper, and paperboard, and four recycled commodities. The United States and Canada are divided into 11 supply and 9 demand regions; the rest of the world consists of 3 net demand regions. A baseline simulation is presented that covers the period from 1980 to 2000. The results of alternative simulations, in which key assumptions of the baseline simulation are altered, are also presented.

PELPS: Price-Endogenous Linear Programming System for Economic Modeling

Gilliss, J. Keith; Buongiorno, Joseph
College of Agricultural & Life Sciences Research Report R3329, University of Wisconsin-Madison. (Available from Department of Forestry, University of Wisconsin, Madison, WI 53706. No Charge.)

This document provides documentation and user information for PELPS, a system of computer programs to model economic sectors. Originally developed for the North American pulp and paper industry, the system can be used for any sector with many regions and commodities. The object of PELPS is to predict production, consumption, shipments, and prices of commodities in each region subject to specific scenarios regarding key macroeconomic variables such as population, income, and manufacturing costs. The document contains a mathematical description of the model as well as a detailed user guide for the computer programs.

Technology Development for Increased Use of Hardwoods

Ince, Peter J.
In: Proceedings, 4th biennial southern silvicultural research conference; 1986 November 4-6; Atlanta, GA. USDA Forest Serv. Gen. Tech. Rep. SE-42; 1987: 3-7. (Available from Publications; Southeastern Forest Experiment Station (SE), 200 Weaver Blvd., P. O. Box 2860, Asheville, NC 28802.)

This paper addresses ongoing technology developments for increased use of hardwoods. Technological and economic developments are described that are reducing the advantage of softwood over hardwood as a preferred wood raw material.

36. The Outlook for the Use of Wood Products in New Housing in the 21st Century

Marcin, Thomas C.
Forest Prod. J. 37(7/8): 55-61; 1987.

This paper examines recent trends in the use of wood products for housing and discusses future prospects for end uses such as framing.

sheathing, and exterior siding. Projections of homebuilding and of wood products use in housing are presented for the period from 1990 to 2030.

37. The Stumpage Market Impact of Timber Utilization Research

Skog, Kenneth; Haynes, Richard
Forest Prod. J. 37(6): 54-60; 1987.

This paper evaluates the potential impact that adoption of recent timber utilization innovations could have on forest products markets through 2030, using the Timber Assessment Market Model (TAMM) maintained by the USDA Forest Service. The analysis uses the projected utilization improvements identified by Haygreen et al., but removes a key assumption that constrains their analysis, that is, that stumpage prices will not be influenced by changing utilization of softwood and hardwood. The analysis was prepared for managers of utilization research, forest policy decision-makers, and research scientists concerned with the impact of utilization innovations.

tropical wood utilization

38. Subtropical Testing of ACA-treated Hardwood Particleboard

Hall, Henry J.; Gjovik, Lee R.; Schmidt, Elmer L.; Gertjeansen, Roland O.; Laundrie, James F.
Forest Prod. J. 37(4): 49-53; 1987.

Flakes of 22 Ghanaian hardwood species (in equal weight proportions) were treated to four retentions of ACA (zero, 0.2, 0.4, and 0.6 lb/ft³, or zero, 3.2, 6.4, and 9.6 kg/m³ based on particleboard volume), and manufactured into phenolic-bonded structural type particleboards using 5 percent or 8 percent resin solids. Stakes from panels were installed in the ground in the Caribbean National Forest of Puerto Rico; they were evaluated for assay and decay and termite resistance after 7 years of exposure.

wood bonding systems

39. Procedure for Measuring Formaldehyde Liberation from Formaldehyde-Based Resins

Myers, G. E.; Koutsky, J. A.
Forest Prod. J. 37(9): 56-60; 1987.

A method is described for measuring formaldehyde released as vapor from formaldehyde-containing solids (e.g., cured urea-formaldehyde resins or model compounds) rather than formaldehyde released from solids slurried in aqueous systems. The method is simple and straightforward, and it permits formaldehyde liberation to be determined as a function of time, temperature, humidity, and resin structure and composition.

40. Adhesive Bonding of Acetylated Aspen Flakes, Part 1. Surface Changes, Hydrophobicity, Adhesive Penetration and Strength

Rowell, R. M.; Youngquist, J. A.; Sachs, I. B.
Int. J. Adhesion and Adhesives 7(4): 183-188; 1987.

This paper investigates the changes that occur in the surface of aspen flakes due to acetylation and determines the hydrophobicity of acetylated flakes by fiber saturation point (FSP) and equilibrium moisture content (EMC) tests. It also determines the extent of resin penetration of a water-soluble phenol-formaldehyde adhesive into acetylated flakes and determines if board failure is caused by surface changes due to acetylation or to adhesive failure due to poor resin penetration.

A complimentary copy may be obtained for publications in the list that are preceded by a number:

- 1) Circle the appropriate number(s) below.
- 2) Make any necessary address corrections on mailing label on back cover. (Do not remove label. It is used for mailing your publication.)
- 3) Clip off this card and mail in an envelope to

Information Services
U.S. Department of Agriculture
Forest Service
Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705-2398
USA

Cut Along Line

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40

Note: Supplies of these publications are limited. If you no longer wish to receive this publication, ask us to delete your name from our mailing list.

U.S. Department of Agriculture
Forest Service
Forest Products Laboratory
One Gifford Pinchot Drive
Madison, Wisconsin 53705-2398

Official Business
Penalty for Private Use \$300

Address Correction Requested

Bulk Rate
Postage & Fees
Paid
USDA-FS
Permit No. G-40

Cut Along Line

DO NOT REMOVE LABEL

87/2

Idalia P. Acosta
Head, Serial Branch
USDA, NAL
Technical Services Division
Beltsville

Acosta
00001082
DIVISION
MD-20705

20705